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APG D/A ltr, 9 Apr 1970

Development and Proof Services

AUTOMOTIVE DIVISION

REPORT ON

ENGINEER DESIGN TEST OF HOWITZER, LIGHT, SELF-PROPELLED, 105-MM, XM104

by

P. GERARD

Report No. DPS-955

(AMCMS Code No. 5564.12.42703.05.1)

(D. A. Project No. 545-03-030)

MAY 1963

Aberdeen Proving Ground
Maryland

DEVELOPMENT AND PROOF SERVICES
ABERDEEN PROVING GROUND
MARYLAND

AUTHORITY: SMOTA-REE PGerard/mvr

ENGINEER DESIGN TEST OF HOWITZER,

LIGHT, SELF-PROPELLED,

105-MM, XM104

Report No. DPS-955

Dates of Test: September 1962 to February 1963

ABSTRACT

The XM104 self-propelled howitzer, pilot No. 3, was tested to determine the readiness of the weapon system for engineering and user tests. The automotive program consisted of amphibious operations and 4000 miles of endurance testing. Amphibious capabilities are limited by low drawbar pull and by maneuverability which is influenced by wind effects on the canvas enclosure; carbon monoxide concentrations are also a potential hazard. Track life is unsatisfactory and component service life and maintenance are adversely influenced by vehicle vibration. It is recommended that the vehicle undergo engineering and user tests after the appropriate modifications are made in the problem areas revealed during this test.

CONTENTS

HOWITZER, LIGHT, SELF-PROPELLED, 105-MM, XM104

ARMAMENT
- Main Gun: 105-mm, XM103
- Secondary: None
- Recoil Mechanism: XM39 Hydropneumatic

AMMUNITION
- 105-mm - 10 rounds

FIRE CONTROL
- Traverse and Elevating Mechanism: Manual

ARMOR
- None

PERFORMANCE
- Max Speed: 35 mph
- Max Grade Ascending Ability: 60%
- Turning Radius: Pivot
- Cruising Range: 250 miles
- Trench Crossing: 60 in.
- Fording: 30 in.
- Vertical Obstacles: 24 in.
- Gross HP to Weight Ratio: 15.3 hp/ton
- Fuel Consumption: Over-all APG 4.97 mpg

FINAL REDUCTION
- Type: GS-100-3
- Ratio: 4.17 to 1

WEIGHT
- Air Transportable: 7200 lb
- Combat Loaded: 8600 lb

CREW: 4

FUEL CAPACITY: 50 gal

DIMENSIONS
- Length (including spade and gun): 160 in.
- Length (excluding spade and gun): 119 in.
- Height (gun in travel position): 69 in.
- Width: 69 in.

GROUND PRESSURE: 4.0 psi

GROUND CLEARANCE: 13 in.

ENGINE:
- M151 Model, 4-cylinder, in-line, liquid-cooled, overhead valve, spark ignition, 141.5 cu in., 66 hp at 3900 rpm

TRANSMISSION:
- Model 540, 5-speed, synchromesh and dry-type disk clutch

STEERING:
- Model GS-100-3 geared steer and brake, wheel-operated

SUSPENSION:
- Torsion bar, 4 pairs of individually suspended road wheels, band type track

ELECTRICAL SYSTEM: 24 volt

Figure 1: Characteristics Photograph.

1. INTRODUCTION

To meet a projected type-classification date of June 1963, combined development tests were to be conducted at Aberdeen Proving Ground, Yuma Test Station, and Ft. Wainwright, Alaska. It was proposed that much of the development test data would be used in lieu of or applicable to the engineering tests on the vehicle thus reducing the over-all program time.

The purpose of these development tests was to prove the adequacy of the XM104 vehicle for engineering and user tests. Four pilot models were produced and assigned to the following test sites:

Pilot No. 1 - Erie Ordnance Depot.
Pilot No. 2 - Yuma Test Station.
Pilot No. 3 - Aberdeen Proving Ground.
Pilot No. 4 - Ft. Wainwright.

It was planned that the data obtained from these pilot models would be used in the production of pilots No. 5 and 6. Pilot No. 5 is scheduled for service testing by the user at Ft. Sill, beginning in April 1963. Pilot No. 6, the final pilot, will undergo engineering testing at Aberdeen Proving Ground, also beginning April 1963 - 1 months before the type-classification date.

The extent of tests of pilots No. 1 through 4 was limited to the determination of the adequacy, readiness, and suitability of the weapon system for engineering and service tests. A test directive, dated 30 April 1962, was issued using standard OPM subjects. This directive indicated the test phases which pilots No. 2, 3, and 4 were to undergo at the respective locations.

This report covers the entire automotive testing of pilot No. 3 at APG as outlined in the test directive. Upon receiving the vehicle at APG, the original plan to conduct artillery evaluations before the automotive evaluation was reversed. This was necessary because of the unavailability of some artillery components at that time.

2. DESCRIPTION OF MATERIEL

The Howitzer, Light, Self-Propelled, 105-mm, XM104 is a highly mobile weapon. It is capable of being transported by helicopter or assault aircraft and it can be air dropped. The vehicle carries a 4-man crew and is designed to provide close-in artillery support. The chassis is of riveted aluminum construction with no superstructure.

An independently mounted gun at the rear of the chassis is fired manually and traversed mechanically. The gun is supported in a cradle-type travel lock when the vehicle is being operated. A mechanically-operated spade at the rear of the vehicle and a set of hydraulic-suspension lock outs anchors the vehicle during firing.

The vehicle power pack consists of: a 4-cycle, in-line, liquid-cooled, gasoline engine as used in the M151, 1/4-ton vehicle; a 5-speed manual synchromesh transmission; a dry-type disk clutch; and a GS 100-3 geared steer unit.

The suspension system uses a band track driven by front-mounted sprockets. Four dual-mounted road wheels on each side of the vehicle are individually sprung by torsion bars. The first and fourth road wheels are provided with shock absorbers. The fourth road wheel is used to adjust track tension.

Figure 1 shows the more pertinent vehicle characteristics. General-view photographs are included in Appendix B.

3. DETAILS OF TEST

3.1 Preliminary Operation

3.1.1 Procedure. The vehicle, pilot No. 3, US Army Registration No. 12T431, was received at APG on 13 September 1962. The weight as received was 7280 pounds.

An initial vehicle inspection was completed before the vehicle was released to the Artillery Division for proof firing of the weapon. From 20 September to 12 October 1962, the vehicle was used in several demonstrations and was operated 25 miles during this time.

The OVE stowage and 700 pounds of simulated payload were placed in the vehicle making a gross weight of 8600 pounds. General-view photographs of the vehicle were taken at the beginning of the test. It was necessary to retake these photographs due to receipt of a new muzzle brake and redesigned spade. In addition, the fire-control systems were not available until late in the test.

A radio interference test was conducted on the vehicle while it was parked on the south loop of the dynamometer test course. This test was performed by personnel of East Coast Detachment, Field Station No. 1, US Army Electronics Research and Development Laboratory.

3.1.2 Results. During this phase of the test program, various defects were observed.

3.1.2.1 Voltage Regulator. During initial inspection, battery water was found shooting out of the batteries when the engine was accelerated. An electrical check indicated that the voltage regulator, serial No. 502740-101, was allowing 34 volts of electricity to pass through the system at one-third throttle. The only adjustment on the regulator, which was a sealed unit, was by moving a wire within the unit to one of four positions. Immediately above each of three positions were faint hand-scratched numbers. No change in regulation was noted by relocation of the wire to any position.

The voltage regulator was replaced and the failed unit returned to ATAC.

The regulator had apparently failed prior to receipt at APG, since the battery water which had blown onto the reflector and telescope straps had rendered the straps unserviceable.

3.1.2.2 Stowage. A bag assembly, 5140-473-6256, was issued as an item of OVE for stowage of miscellaneous hand tools. The bag and tools are carried on the vehicle in the spade compartment; however, the lid for the spade could not be secured because there was no wrench available for tightening the 9/16-inch self-retaining screws. Conversely, if the compartment lid has been secured, the bag and tools cannot be removed because of nonavailability of the 9/16-inch wrench.

A 9/16-inch speed wrench should be issued as part of the OVE and the wrench stowed on the vehicle where it is easily accessible to the crew.

3.1.2.3 Engine Air-Cleaner Cover. The air-cleaner cover has a small circular opening to allow air to pass through the air-cleaner element (Figure 2). This opening is sufficiently large that mud and water, when splashed up over the front of the vehicle, enter through this hole into the air-cleaner element. Also, when the vehicle is being washed, mud and water are very likely to be splashed into the cleaner element. When the element was cleaned, small pebbles were found lodged in it.

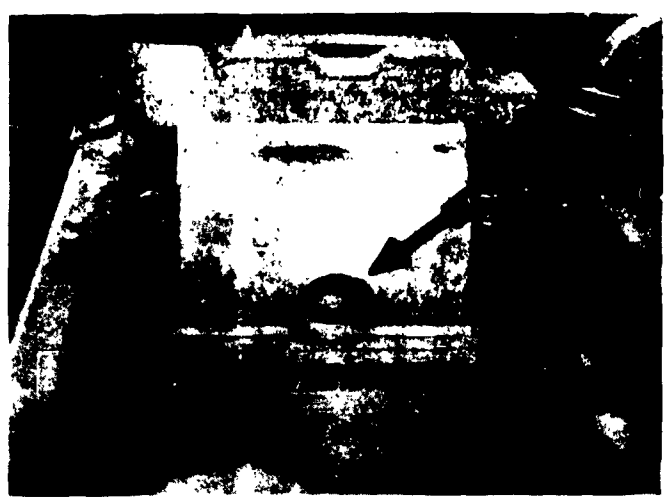

Figure 2: Engine Air Cleaner and Cover.

A possible solution to this problem would be the installation of a small grille structure over the opening designed to allow air to pass but restrict the entry of mud, water, and other foreign particles.

3.1.2.4 Radio Suppression. Radio interference tests revealed that the suppression system of the vehicle conformed to the tactical vehicle requirements of MIL-S-10379A. No radio interferences were detected. A complete report on the radio suppression test is contained in Appendix F.

3.1.2.5 Battery Eyebolt. To remove the battery cover, the wing nut on the eyebolt must be loosened sufficiently to allow the eyebolt to fall clear of the battery cover. When extreme care is taken in loosening the wing nut, there are one or two threads still holding the nut when the eyebolt falls free of the cover. If extreme care is not taken, the nut will come off the eyebolt and possibly fall into the engine compartment or other inaccessible areas.

The length of the eyebolt and threads should be extended to insure that sufficient threads are available to retain the nut on the eyebolt when the battery cover is being removed.

3.1.2.6 Engine and Transmission Covers. The engine and transmission covers contain several access plates for gaining access to the engine, transmission, and radiator. These small plates use a piano hinge and are opened by removing or loosening a bolt and raising the lid directly up. When the 105-mm gun is in the travel-lock position, several of the plates, when raised, strike the gun and fall back closed.

Consideration should be given to using a pivot hinge on all access plates of the engine and transmission covers for the following reasons:

a. To eliminate the problem of covers falling closed accidentally.

b. To permit repairs in the field to be made more easily.

3.2 Engineering Performance Evaluation

3.2.1 Procedure.

3.2.1.1 General. This phase of the test consisted of limited engineering performance tests conducted by the Automotive Engineering Laboratory. Except for fuel consumption determinations conducted in the Munson Test Area, all of these tests were confined to amphibious operations.

The majority of the engineering performance tests were conducted at Yuma Test Station, on pilot No. 2, in accordance with the test directive (Appendix A).

3.2.1.2 Instrumentation. The power pack was removed and the necessary instrumentation, consisting of thermocouples, engine tachometer, and fuel-consumption apparatus, was installed.

3.2.1.3 Amphibious Operation. The amphibious operation consisted of the determination of maximum angle of approach and exit, maneuverability, turning radius, water speeds, and drawbar pull with and without water vanes.

These vanes were furnished by Detroit Arsenal and consisted of welded-steel sections similar to the vanes on the M116 cargo vehicle. They were bolted to the vehicle above the No. 1 and 2 road wheels in place of the fabric skirts (Figures 3 and 4).

Figure 3: Water Vanes.

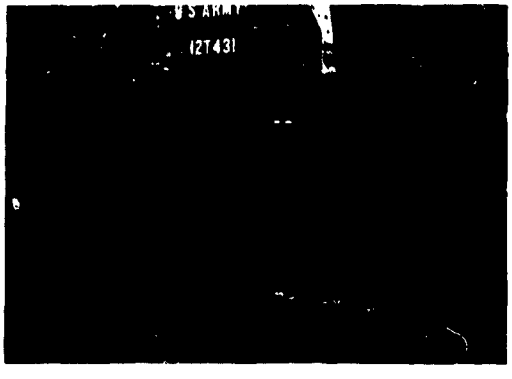

Figure 4: Water Vanes Installed.

3.2.2 Results. Some of the more pertinent data from the performance tests are presented in the following paragraphs. Additional details are contained in the laboratory report (Appendix D).

3.2.2.1 Fuel Consumption. Fuel economy of 4.6 to 6.2 mpg was realized on the Munson Test Area standard fuel course at 9.7 to 22.6 mph road speed. This is considered to be satisfactory compared to other track-laying vehicles such as the M116 and T114.

3.2.2.2 Water Speeds. A maximum water speed of 2.6 mph was obtained in third land gear, but maneuverability was considerably better in the water-gear ranges. The water vanes had little effect on vehicle water speed. It is of interest that fourth water gear resulted in better vehicle control, lower fuel consumption, and less engine noise with only a slight loss of water speed.

3.2.2.3 Drawbar Pull. A maximum drawbar pull of 190 pounds was obtained in the water. There was no significant change when the water vanes were used.

3.2.2.4 Approach Angles. The vehicle was able to enter the water at an entrance angle of 17° and leave at an exit angle of 13.5° without encountering any noticeable difficulty.

3.2.2.5 Stability and Maneuverability. Stability of the vehicle in the water was considered satisfactory, but the flat surface of canvas acted like a sail resulting in both desirable and undesirable effects. Minimum turning radii can be obtained in first water gear with due allowance for prevailing wind and water currents.

3.2.2.6 Engine Cooling (Water Operation). Full-throttle cooling tests during amphibious operation revealed that engine cooling was unsatisfactory. The temperature of the coolant out of the engine was 194°F in an ambient air temperature of 52°F. Extrapolated to an ambient of 115°F, the water temperature out of the engine would be 257°F. Assuming 100% efficiency of the 7-psi pressure cap, the allowable water temperature out of the engine would be 225°F.

It should be pointed out that, during cooling tests in high ambient temperatures at Yuma Test Station, Yuma, Arizona, engine cooling was also unsatisfactory. A series of cooling tests was conducted varying the fan-blade pitch, number of blades, and fan speed. Satisfactory cooling was eventually realized.

It is reasonable to assume that these fan-blade changes would also correct the cooling problem during amphibious operation.

3.2.2.7 Carbon Monoxide. The engine exhaust is discharged directly into the vehicle during amphibious operation. Although the vehicle is completely open, operating personnel may still inhale relatively large amounts of carbon monoxide. A CO concentration in excess of 0.1% was recorded at the right rear personnel seat. A concentration of 0.01% is acceptable.

3.2.2.8 Flotation Kit. After approximately 10 minutes of water operation, water began to pour in over the right rear corner of the hull. A check of the curtain riser revealed that water was entering through the first three or four bolt holes in the right side of the vehicle. After the water passed through the curtain, it was trapped in the trough formed between the riser and the hull of the vehicle. The water then flowed to the right rear corner of the vehicle as this was the lowest point.

A further inspection of the curtain riser revealed that the holes which had been punched in the riser to accept the securing bolts had become elongated and frayed. The holes should be reinforced so they are not readily frayed and are capable of sealing out water.

3.3 Endurance Operation

3.3.1 Procedure. This phase of the test consisted of vehicle operation on various test courses to determine the endurance limit of the vehicle and to evaluate ease of maintenance as well as economy. Operation on the various courses was accomplished in approximately 500-mile cycles at maximum course speeds commensurate with course condition and safety.

Security from detection, OPM 60-55, was requested in the test directive, but it was decided by Army Tank Automotive Center to perform this test on a forthcoming pilot model. Also, no formal mobility test (OPM 60-85) was conducted. This was also deferred to be conducted on the next pilot vehicle.

The vehicle was lubricated and the track was adjusted according to technical manual specifications throughout the test. At odometer 1238, cambered-suspension road-wheel arms were installed and the spade struts and locks were replaced. The spade was also modified to accept the 24-inch spade extensions. The cambered suspension was removed after 170 miles of operation due to premature component failure.

At odometer 1414, eight shoe-track sections were installed in each track for test purposes. These and the original shoes were periodically measured for track wear.

The winterization kit was installed at odometer 1795. A replacement howitzer and recoil mechanism were installed on the vehicle for part of the test while the original units were at Rock Island Arsenal for other tests.

The track bands were shipped to Detroit Arsenal at odometer 3434 for rebuilding on 20 December 1962 and returned on 8 January 1963.

A final inspection was performed on the vehicle. The vehicle was then repainted and the latest-design gun tube, recoil, and sighting system installed. General-view photographs were taken and the vehicle was released to the Artillery Division.

3.3.2 Results.

3.3.2.1 General. Total accumulated mileage was as follows:

Odometer at completion of test	4177
Odometer at beginning (as received)	115
Total	4062

A summary of operations is shown in Table I.

Table I. Operation Summary, in miles

Hard surface	1003
Hills (Churchville)	1000
Cross-country (Perryman)	1008
Gravel	1000
Amphibious	51
Total	4062

Total fuel consumption	815.9 gal
Over-all fuel consumption	4.97 mpg
Oil consumption to odometer 2611	0

A list of defects is shown in Table II.

Table II. Defects

SNL Group	Item	No. of Defects
01	Engine	4
03	Fuel system	1
04	Exhaust	2
06	Electrical	4
07	Transmission	1
09	Propeller shaft	1
13	Tracks and suspension	6
14	Controls	3
15	Frame and brackets	2
17	Fenders, guards, shields	2
18	Hull and cab	4
20	Recoil spade	1
22	Miscellaneous accessories	1
30	OVE	2

A summary of defects is included in Appendix G.
A maintenance engineering report is in Appendix E.

3.3.2.2 Fuel Consumption. The over-all fuel consumption rate for the 4062 miles of endurance operation was 4.97 mpg. Periodic checks indicated a range of 6.69 to 4.06 mpg on the various test courses.

3.3.2.3 Oil Drainage, Engine and Transmission. The procedure of draining the engine and transmission oils directly into the vehicle hull and then into a drain pan under the vehicle was very impractical. This was due to the fact that hull drain holes were not aligned with engine and transmission drain plugs. It is impossible to clean out all the oil in the hull and this remaining oil then becomes a potential fire hazard. Pilot vehicles No. 5 and 6 are to have this condition remedied.

3.3.2.4 Track Wear. Periodic track-wear measurements indicated that the tracks wore at a slightly faster rate when they were new. An over-all wear rate of approximately 0.15 inch per 1000 miles of operation resulted. Complete track-wear data are included in Appendix C.

3.3.2.5 Cambered Suspension. At odometer 1238, the road-wheel arms, sprocket hubs, and shock absorbers were replaced. The new road-wheel arms were designed to cause the second and third road wheels to have a camber pitch resulting in more even road-wheel loading and wear on the tracks.

After 170 miles of operation, the No. 3 right road-wheel arm failed (Figure 5). Since spare parts were not available, the original suspension components were reinstalled.

Figure 5: Failed Experimental Road-Wheel Arm.

3.3.2.6 Tube and Screen Assembly, Engine-Oil Pickup. The engine-oil pickup tube and screen assembly (Figure 6) broke during hilly cross-country operation. The vehicle oil pressure would drop to about 5 psi and the engine would cease operation when attempting to climb a hill. Oil pressure returned to about 40 psi when operating on level terrain.

The wall thickness of the tube was 0.065 inch. A replacement tube and screen assembly, which had the same wall thickness, was installed and operations continued satisfactorily for the remainder of the test.

This failure was prevalent when testing the M151 1/4-ton truck. The assembly was then modified to prevent the part from failing. However, as the assembly which failed was of this modified type, further modifications are required.

This same type of failure was experienced on XM104 vehicles tested at other installations.

A reinforcing brace has been added to the oil pickup and tube assembly used on pilot vehicles No. 5 and 6 in an attempt to eliminate this failure.

Figure 6: Failed Engine-Oil Pickup Tube.

3.3.2.7 Tracks. Cracks, cuts, and bubbles were noted in the rubber bands at 2600 miles. During cross-country operation at odometer 3098, the inside track band of an 8-shoe section in the left track failed. The break was 14-1/2 inches from the front of the section. The two track shoes immediately behind the break in the band were also damaged. A section of used track was installed to permit continued operation.

While operating on the paved course at odometer 3388, the right track began bumping against the underside of the vehicle. It was found that the steel cables were pulling out of the rubber band on the outside of the track.

Both tracks were shipped to Army Tank Automotive Center for inspection and rebuild and then returned to Aberdeen Proving Ground for additional operation. Army Tank Automotive Center personnel attributed the track failures to insufficient rubber encasing the cables.

After the rebuilt track had operated 312 miles, six center guides of the left track failed (Figure 7).

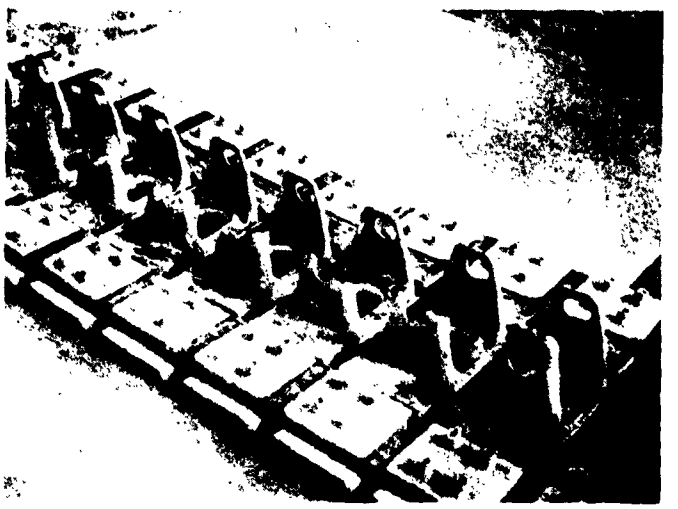

Figure 7: Failed Center Guides in Left Track.

The vehicle had been operating on the level cross-country course on frozen ground and was having difficulty maneuvering between large ruts made by an M60 tank. The left tracks were on the lower side of a slope when the track came off. The No. 4 road wheel was damaged also. Replacement guides and a new road wheel were installed. The tracks completed the remainder of the test without further failures.

Pilot vehicles No. 5 and 6 will employ redesigned tracks having cast center guides and thicker rubber sections encasing the cables.

3.3.2.8 Alternator. An alternator failure, discovered at the end of endurance operation (odometer 4177), resulted in loss of battery charge. This is a serious defect since loss of electrical power means loss of engine operation. This failure probably resulted from attaching a slave starter in reverse polarity, a failure which can be eliminated by the addition of a simple circuit breaker.

3.3.2.9 Air-Cleaner Element. During a 750-mile maintenance check at odometer 3099, it was found that the adjustable mounting flange was not fitting properly against the air cleaner. The flange, which is metal, had been tightened against the end of the air-cleaner element, which is rubber, and caused the element to be deformed preventing a proper seal. Dust entered through the gap and had contaminated the engine. It is impossible to know positively how many times the improper installation of the air cleaner had been accomplished prior to odometer 3099. Excessive oil consumption necessitated engine replacement at odometer 3302.

Because of the confined area in which the air-cleaner element must be installed and the poor design of the present mounting flange, consideration should be given to procuring a new type of flange. The new flange should seal out all impurities and not deform the cleaner element when it is tightened down.

3.3.2.10 Stowage Facilities. The stowage facilities on the vehicle, except for the compartment in the spade, are satisfactory. During amphibious operations or on muddy or dusty courses, it was obvious that the spade compartments were not sealed properly to prevent the entry of water, mud, or dust.

3.3.2.11 Steering System. Steering of the vehicle was found to be generally acceptable; however, a new driver had to familiarize himself to the steering sensitivity. It was felt that a smaller capacity steer unit could be considered for this vehicle. The following items within the steer-control system require improvement:

a. Steering-Linkage Cross Shaft. After about 1000 miles of operation, it became increasingly difficult to turn the steering wheel when attempting to turn the vehicle. Within a very short time it was impossible to steer the vehicle. The shaft (Figure 8) was removed. It had become covered with dirt and other foreign matter and was binding so that it would not rotate when steering was attempted.

   A grease fitting should be installed in the housing to prevent further deficiencies of this nature.

Figure 8: Steering-Linkage Cross Shaft.

b. Steering Column Spring. At odometer 2845, while operating on the level cross-country course, the steering column would fall to the floor whenever the driver applied any forward pressure on the steering wheel. It was found that the spring which provides tension on the steering-column latch had become too weak to maintain the column in the upright position. A new spring was installed. A stringer spring should be employed in this location.

3.3.2.12 Human Engineering. Throughout the endurance operation, the comfort, efficiency, and ease of operation for the crew were observed and no objectionable characteristics were noted.

3.3.2.13 Vibration. A number of conditions and failures could be attributed to vehicle vibration.

a. Road-Wheel Lug Nuts. These nuts became loose and required frequent tightening.

b. Fire-Control Sights. During artillery tests bore-sight retention was difficult, probably due to induced vibration.

c. Gun-Travel Lock. During firing, the gun-travel lock is pivoted out of the way by the use of two through-holes in the travel-lock legs. Two bolts extend through these holes and secure the travel lock to the vehicle. Because of this clearance between the hole and bolt, the holes elongated from the constant vibration of the gun during vehicle operation (Figure 9).

Figure 9: Elongated Holes in Gun-Travel Lock.

d. Ammunition Storage Compartments. Cracks occurred in the corners of the ammunition storage compartments from the outside corner of the metal to the bolt holes (Figure 10). These compartments were loaded with a simulated payload for the endurance operation.

Figure 10: Right-Side Ammunition-Storage Compartment.

Figure 11: Driver's Protective Panel.

e. Driver's Protective Panel. The driver's protective panel cracked (Figure 11). In addition, the support paneling near the left side rear seat-latch handle and the right side front seat inboard support paneling had cracked approximately 1/2 inch in the welds. All these cracks were apparently caused by vehicle vibrations.

f. Engine-Oil Pickup Tube and Screen Assembly. Failure of the tube in this unit is discussed in paragraph 3.3.2.6. The failure can be attributed to vehicle vibration.

4. CONCLUSIONS

It is concluded that:

a. The XM104 self-propelled howitzer is ready for engineering and service user tests of the automotive components provided modifications are made in those problem areas discovered during this test.

b. Track life is unsatisfactory. A band failure occurred at 3100 miles and impending failure was indicated at 2600 miles (ref par. 3.3.2.7).

c. The engine-oil pickup tube and screen assembly was unsatisfactory. Tube failure which occurred was probably a result of vibration (ref par. 3.3.2.6).

d. The air-cleaner element rubber flange is subject to permanent deformation and introduces a possible point of entry of dust into the engine (ref par. 3.3.2.9).

e. Failures of the engine-oil pickup tube and sheet metal components, elongation of gun travel-lock holes, and inability to maintain bore-sight retention and proper road-wheel lug torque are attributable to vehicle vibration (ref par. 3.3.2.13).

f. The amphibious capabilities of the vehicle are influenced or limited by the following:

(1) Engine coolant temperatures exceeded the specification limits. However, indications from high-ambient desert testing are that a satisfactory cooling system has been developed (ref par. 3.2.2.6).

(2) Drawbar pull in water is very limited; a maximum pull of 190 pounds was attained. The use of water vanes for more effective propulsion produced no significant improvement (ref par. 3.2.2.3).

(3) Maneuverability is affected by the action of the wind on the flat canvas surfaces which act like sails (ref par. 3.2.2.5).

(4) Engine exhaust is discharged directly into the enclosure formed by the canvas curtain riser making possible the accumulation of excessive carbon monoxide concentrations (ref par. 3.2.2.7).

5. RECOMMENDATION

It is recommended that the XM104 self-propelled howitzer undergo Engineer and Service tests after appropriate modifications are made in those problem areas revealed during this test.

SUBMITTED:

PETER A. GERARD
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Chief, Automotive
Division

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ROBERT G. SAMUEL
Lt Col, Ord Corps
Deputy Director for
Engineering Testing

REFERENCES

1. Letter from J. Byrne, APG, D&PS, ORDBG-DPS-TA to Chief of Ordnance, ATTN: ORDTW, Dept of Army, Washington 25, D. C. (Copies to OTAC and Detroit Arsenal), dated 16 April 1962, "Concerning Engineering Test Plan for 105-mm Howitzer, Self-Propelled, XM104 (U)."

2. TM 9-2350-228-10 -- Preliminary-Operations Manual for XM104, July 1962.

3. TM 9-2350-228-20 - Preliminary-Organizational Maintenance for XM104, July 1962.

4. TM 9-2350-228-20P - Preliminary-Repair Parts List for XM104, July 1962.

5. Engineering Test Plan, 105-mm Howitzer, Self-Propelled, XM104 (U).

APPENDICES

APPENDIX A

Correspondence

HEADQUARTERS MMCleary/ad/35167
UNITED STATES ARMY ORDNANCE TANK-AUTOMOTIVE COMMAND
1501 BEARD, DETROIT 9, MICHIGAN

In Reply Refer To:
ORDMC-REE 30 April 1962

SUBJECT: Test Directive for Howitzer, Light, S.P., 105MM, XM-104

TO: Commanding General
Aberdeen Proving Ground
ATTENTION: Mr. Noble
Aberdeen, Maryland

1. The following is the development test directive for work to be performed at Wainwright, Yuma, and Aberdeen Proving Ground, for the purpose of determining the suitability of the XM-104 Weapon System for combined Engineering and Service test.

2. This test plan has been developed with the cooperation of Mr. H. Noble, Mr. J. Byrne, Mr. D. Misiora, during the two-day meeting at OTAC on 25-26 April. It is, in the opinion of OTAC and your representatives, feasible and, under the circumstances, the most direct approach to early type classification.

3. It was estimated at the meeting on 25 April that the cost of the necessary development testing will be in the neighborhood of $150,000. It is requested that your proving ground supply this command with separate cost estimates for each of the sites so that the necessary program authority can be furnished. This authority should be available early in July.

4. Purpose of Test: As indicated in paragraph 1, the purpose of these development tests is to prove the adequacy of the vehicle for engineering and user tests. This plan has been formulated so that maximum use of these tests may be made in lieu of additional engineering tests. By this method, only minor supplementary tests need be made at the conclusion of the developmental phase, and maximum use of the time available will be made.

5. Priority: 1A - 39th on Ordnance Corps Priority List

6. Background: The XM-104 is a highly mobile self-propelled, full tracked, 105MM howitzer. It is capable of being transported by HC-1B Helicopter or assault aircraft and delivery by airdrop. The vehicle carries a crew of four, and is designed to provide close in artillery support. The chassis is of riveted aluminum construction with no superstructure and with an independently mounted gun at the rear of the chassis. The gun is fired manually and is traversed mechanically and elevated hydro-mechanically. During travel and when not in operation, the gun tube is supported by a cradle fastened to the forward edge of the vehicle. A mechanically operated spade, mounted at the rear of the vehicle, and a set of hydraulic suspension lock-outs anchor the vehicle during firing.

a. The vehicle power pack consists of the following components: A four cylinder, in line, liquid cooled, gasoline engine as used in the M-151, a 5 speed manual syncro-mesh transmission with disc clutch, and the GS100-3 geared steer unit as used in the T-114 vehicle.

b. The suspension system uses a band track driven by front mounted sprockets. Four dual mounted roadwheels on each side of the vehicle are individually sprung by torsion bars. The first and fourth roadwheels on each side are provided with shock absorbers and the front three roadwheels on each side have hydraulic lock-out cylinders. The fourth roadwheel is used to adjust the track tension.

c. Developmental tests on this vehicle were conducted on two test rigs, one for automotive and endurance testing, and the other for firing tests. Further tests were conducted on a mock-up of the power train and engine compartment. These included cooling tests and component tests.

7. Pilot Delivery for Test:

a. Pilot #1 will go to Erie Ordnance Depot for development tests (coordinated with your proving ground at meeting on 25 April 1962).

b. Pilot #2 will be delivered to the Yuma Test Station between 15-20 July 1962. Development tests on this pilot should be completed by October so that the data derived from these tests can be incorporated in Pilot #4.

c. Pilot #3 will be delivered to APG on 15 August 1962. Completion of these development tests by January 1963 will allow the data obtained to be used, to some extent, in the production of Pilots #5 and #6. Pilots #5 and #6 will then be directed for engineering and service tests. For these tests it is requested your proving ground develop a coordinated test plan with this User. OTAC desires to participate in your coordination and notification of developments would be appreciated.

d. Pilot #4 is to be delivered to Ft. Wainwright on 15 November 1962 for Arctic testing through March 1963.

e. Final disposition of the vehicles will be determined by the project engineer at the conclusion of the tests.

8. Procedure: The following tests, as outlined in the Ordnance Proof Manual (OPM) are required for complete evaluation of the weapon system. Site of tests is one of the coordinated decisions of the April 26th meeting. The extent of each test will be sufficient for determination of readiness of the weapon system for engineering and service tests.

Engineering & Performance Tests

	APG	Yuma	Arctic
OPM 60-15 Characteristics	X	X	
OPM 60-20 Deficiency Reports	X	X	X
OPM 60-25 Mechanical Inspection	X	X	X
OPM 60-30 Preliminary Operation	X	X	X
OPM 60-40 Vehicle Fuel Consumption Test	X	X	X
OPM 60-45 Maintenance	X	X	X
OPM 60-50 Standard Obstacles		X	
OPM 60-55 Security from Detection	X		

Engineering & Performance Tests

	APG	YUMA	ARCTIC
OPM 60-60 Load Distribution and Ground Pressure		X	
OPM 60-65 Center of Gravity		X	
OPM 60-71 Braking		X	
OPM 60-72 Drawbar Pull		X	X
OPM 60-73 Power Losses		X	
OPM 60-74 Acceleration and Max.-Min. Speeds		X	
OPM 60-75 Steering	X	X	X
OPM 60-80 Gradeability & Side Slope		X	X
OPM 60-85 Mobility	X	X	X
OPM 60-95 Cooling		X	
OPM 60-100 Vehicle Shock & Vibration	X	X	
OPM 60-105 Toxic Fumes	X		X
OPM 60-110 Stowage	X	X	X
OPM 60-115 Endurance Test Combat Vehicles	X	X	X
OPM 60-130 Amphibious Vehicles	X		
OPM 60-150 Electrical System			X
OPM 60-170 Tracks & Suspension	X	X	X

Engineering & Performance Tests

	APG	YUMA	ARCTIC
OPM 60-175 Radio Interference Tests	X		
OPM 60-185 Gun Control System	X		X
OPM 60-200 Functional Firing	X	X	X
OPM 60-205 Weapon System Performance	X	X	X
OPM 60-210 Boresight Retention	X		
OPM 60-270 Night Performance	X		
OPM 60-280 Accuracy Firing	X	X	X
OPM 60-301 Field Cold Staring & Warm Up			X
OPM 60-302 Personnel Heating Systems			X
OPM 60-305 Human Engineering	X	X	X
OPM 60-390 Ordnance Proving Ground Technical Reports - Formal	X	X	X
OPM 60-391 Ordnance Proving Ground Technical Reports - Memo	X	X	X
OPM 60-392 Ordnance Proving Ground Technical Reports - Firing	X	X	X

The above tests are not necessarily listed in the order in which they are to be performed and may be supplemented at any time by additional tests deemed necessary to the vehicle evaluation.

9. Photographic Coverage: Still and motion pictures will be taken as required to document significant failures and deficiencies, and to illustrate vehicle tests.

10. Reports: Weekly memo reports will be required. Formal reports will be made at the end of each phase.

11. It is requested that this Command be continually advised of the test schedule so that representatives from this Command can be at the various test sites to observe critical portions of the testing.

12. Spare parts other than those classed as Ordnance Standard Parts will be furnished by OTAC, R&D, upon request by the testing agency.

13. Characteristic sheets for this vehicle will be supplied to Aberdeen Proving Ground. Notes on Development Type Materiel will be furnished as soon as they become available.

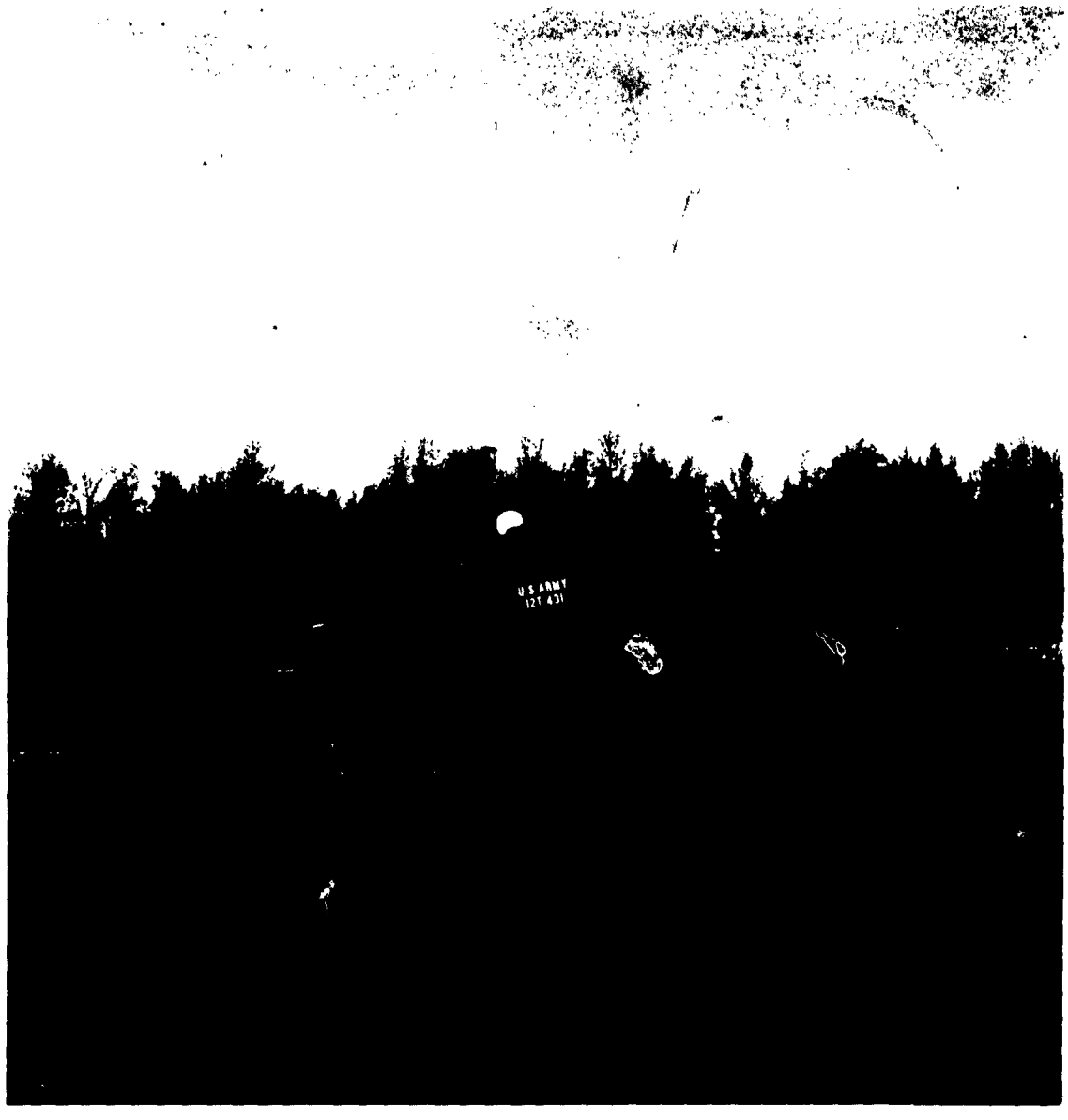
14. Components that fail during tests are to be properly marked and shipped to OTAC, R&D, Detroit Arsenal, to the attention of the XM-104 Project Officer.

FOR THE COMMANDER:

Joseph Tannenbaum

JOSEPH TANNENBAUM
Ch Engr, XM104/2 Weapon System

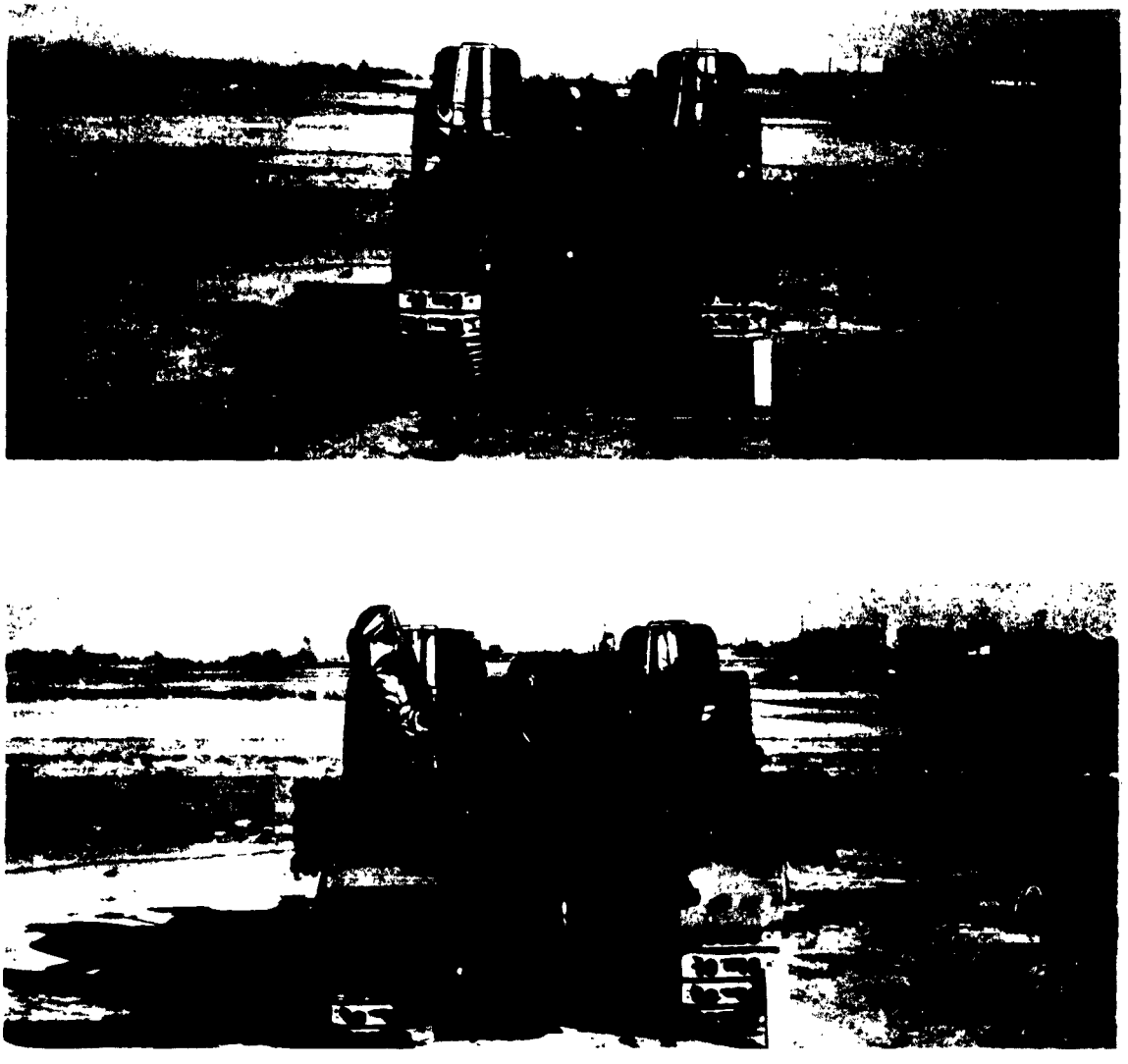
S18-001-C474-P/ORD-63: Three-Quarter Left Front View Vehicle in Firing Position.



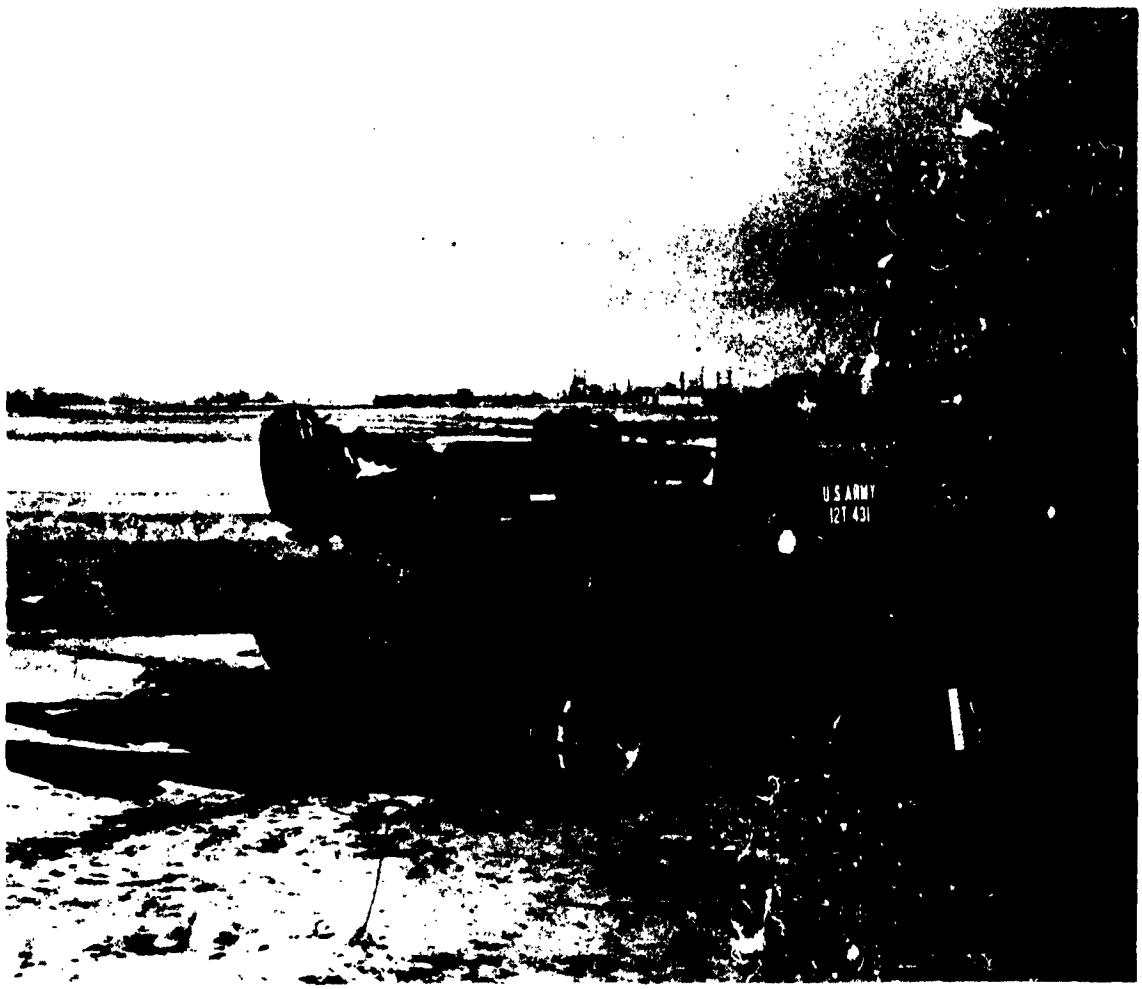
S18-001-C475-P/ORD-63: Twenty-Four Inch Vertical Wall.

S-18-001-C476-P/ORD-63: Crossing 36 Inch Ditch.

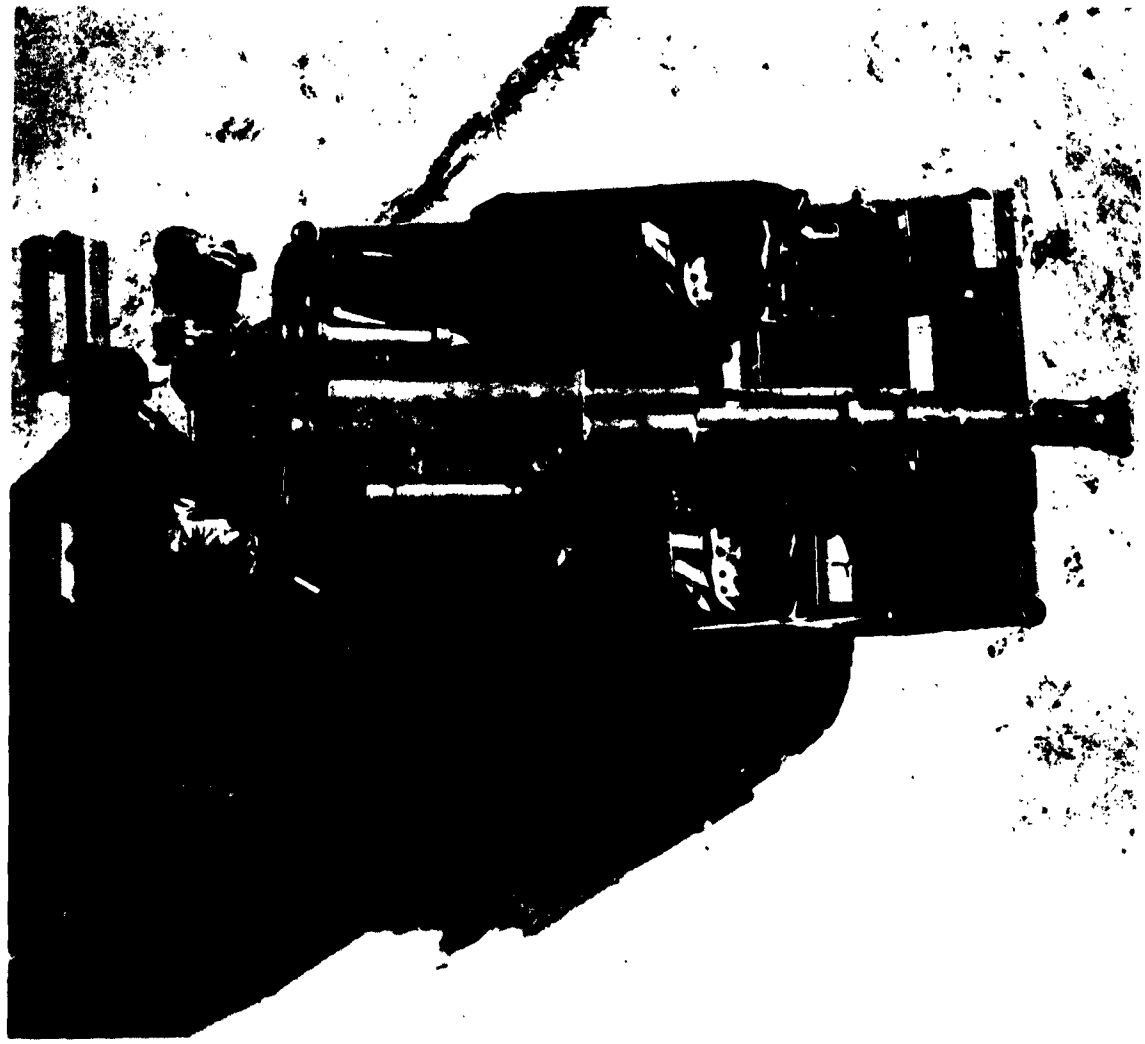
S18-001-469-P/ORD-63: Right Side View Vehicle in Travel Position.



S18-001-473-T/ORD-63: Vehicle in Travel Position.



S18-001-472-T/ORD-63: Three-Quarter Rear View, Right. Vehicle in Travel Position.



S18-001-471-T/ORD-63: Top View Vehicle in Travel Position.

APPENDIX C

Track-Wear Data

Track Measurements (Average of Three Readings to ±1/64)

Odometer Reading	Grouser Height, inches					
	Left Track			Right Track		
	Outside	Center	Inside	Outside	Center	Inside
[a]1238	1.573	1.576	1.560	1.552	1.529	1.493
1748	1.375	1.459	1.364	1.411	1.447	1.312
2519	1.292	1.313	1.208	1.276	1.292	1.209
3099	1.208	1.270	1.146	1.166	1.273	1.104
3701	1.104	1.208	1.000	1.125	1.229	1.063
[b]1414	1.563	1.563	1.563	1.563	1.563	1.563
1748	1.438	1.500	1.438	1.438	1.500	1.375
2519	1.375	1.438	1.313	1.375	1.438	1.313
3099	1.250	1.344	1.156	1.219	1.344	1.156

[a]Original track.
[b]Eight shoe-track sections installed at 1414 miles.

APPENDIX D

Laboratory Report

ABERDEEN PROVING GROUND, MARYLAND

AUTOMOTIVE ENGINEERING LABORATORY REPORT

PROJECT NO: .427C/865

'ska
DATE: 26 November 1962

REPORT NO: 62-117

HOWITZER, LIGHT, SELF-PROPELLED,

105 MM, XM104 PILOT NO. 3

DATES OF TEST: 9 thru 23 November 1962

TABLE OF CONTENTS

INCLOSURES

1 Data Sheet No. 62-117-1

1. INTRODUCTION

1.1 Object of Test

To perform amphibious and standard fuel course tests of Howitzer, Light, Self-Propelled, 105 MM, XM104, Pilot No. 3.

2. RESULTS

2.1 Specific

Fuel economy of 4.57 to 6.15 mpg was realized during standard fuel course operations within the 9.7 to 22.6 mph road speed range.

Water speeds, recorded while negotiating a 1000 foot course, were as follows:

Gear	W/Water Vanes - Mph	W/O Water Vanes - Mph
Water - 3	2.54 @ 4000 rpm	2.51 @ 4000 rpm
Water - 4	2.53 @ 2750 rpm	2.48 @ 2750 rpm
Land - 3	2.62 @ 3300 rpm	2.60 @ 3300 rpm

Fuel was consumed at the rate of 4.75 to 4.95 gal/hr during the full throttle amphibious operations.

Drawbar pull developed with the vehicle afloat was as follows:

Gear	Drawbar Pull - Lb	
	W/Water Vanes - Mph	W/O Water Vanes - Mph
Water - 3		
2000 rpm	4	90
2500 rpm	130	95
3000 rpm	135	115
3500 rpm	160	135
4000 rpm	180	160
Water - 4		
2750 rpm	180	160
Land - 3		
3300 rpm	190	180

The vehicle was able to enter the water at an entrance angle of 17° and leave at an exit angle of 13.5° without encountering any noticeable difficulties.

Complete cooling data are presented on Summary Data Sheet No. 62-117-1. Critical component temperatures recorded during full throttle operations in water - 4 gear at 2750 rpm were as follows:

Water Out of Engine - 142°F above ambient with 7 psi pressure cap

Transmission Oil (Sump) - 126°F above ambient

Engine Oil to Cooler - 125°F above ambient

Gear Steer Oil to Cooler - 144°F above ambient

2.2 Discussion

Amphibious tests were conducted in the Spesutia Narrows where water depth varied from 10 to 14 feet and water currents did not exceed 0.5 mph.

Maximum water speed was recorded in land - 3 gear; however, vehicle maneuverability was considerably better in the water gear ranges. Since the overall speed variation among the three best gear ranges selected was not appreciable, it is recommended that water - 4 gear be utilized for better vehicle control, lower fuel consumption, and less engine noise.

Turning radius data were not obtained with the vehicle afloat due to adverse effects of windage and tide. Although stability of the XM104 was considered satisfactory, difficulty was experienced when attempting to maneuver into the prevailing wind. The flat surface of the canvas inclosure may be likened to sails, being an advantage or disadvantage depending upon wind direction relative to the vehicle and direction of vehicle travel. From general observation of vehicle performance, minimum turning radii will be obtained in water - 1 gear with due allowance for prevailing wind and water currents.

Full throttle cooling test data reveals that the engine coolant temperature was excessive. A water temperature of 194°F with the vehicle immersed in water and an ambient air temperature of only 52°F indicates that a serious cooling problem exists with this vehicle.

The engine exhaust is discharged directly into the vehicle during amphibious operations. Although the vehicle is completely open, operating personnel may still inhale relatively large amounts of carbon monoxide. A "CO" concentration in excess of 0.1% was recorded at the right rear personnel seat. It was necessary to install extra piping to direct the exhaust gases out of the inclosure during these tests. Consideration should be given to modifying the present exhaust configuration for deep water fording. A CO level of 0.01% is accepted; however, any degree of contamination, no matter how slight, has adverse affects on military personnel operating efficiency.

3. DETAILS OF TEST

3.1 Description of Material

The XM104 is a light weight tracked vehicle with amphibious capabilities. It is powered by a 4 cylinder, liquid-cooled gasoline engine. Power is transmitted through a 5 speed synchromesh transmission and a two speed Model GS-100-3 steer unit.

4. CONCLUSIONS

The most acceptable overall amphibious performance will be realized in the water gear ranges, water - 1 gear for minimum turning, water - 4 gear for speed and overall performance.

Vehicle maneuverability is dependent upon windage and water currents while afloat.

Engine coolant temperature failed to comply with general military vehicle cooling specifications outlined in AR 705-15.

Carbon monoxide concentrations within the canvas inclosure were considered excessive.

5. RECOMMENDATIONS

Investigate engine coolant temperature characteristics further and modify cooling system as required to reduce operating temperatures.

Modifiy exhaust piping for fording operations.

SUBMITTED:

C. Domanski

C. DOMANSKI
Engineer

REVIEWED:

R. F. Depkin

R. F. DEPKIN
Acting Chief
Field Engineering Section

APPROVED:

R. W. Johnson

R. W. JOHNSON
Chief
Automotive Engineering Laboratory

HOWITZER, LIGHT, SELF-PROPELLED, 105 MM, XM104

SUMMARY OF FULL THROTTLE COOLING TEST DURING AMPHIBIOUS OPERATIONS

Gear - Water - 4

Engine Speed - 2750 rpm

Track Speed - 12 - 14 mph

	Temperature °F
Water Out of Engine	194
Water to Engine	187
Transmission Oil Sump	178
Fuel at Carburetor	72
Induction Air	64
Engine Oil to Cooler	177
Engine Oil From Cooler	162
Steer Oil to Cooler	196
Steer Oil From Cooler	157
Cooling Air Inlet (Above Steer Unit)	62 - 76
Cooling Air to Radiator	112 - 125
Cooling Air to Radiator	165 - 180
Cooling Air to Radiator	103 - 115
Cooling Air From Radiator	167 - 184
Cooling Air From Radiator	174 - 192
Cooling Air From Radiator	160 - 170
Cooling Air From Engine Oil Cooler	172 - 182
Cooling Air From Engine Oil Cooler	167 - 174
Cooling Air From Gear Steer Oil Cooler	162 - 172
Cooling Air From Gear Steer Oil Cooler	157 - 164
Ambient	52

APPENDIX E

Maintenance Engineering Report

MAINTENANCE ENGINEERING OFFICE

AUTOMOTIVE DIVISION

DEVELOPMENT AND PROOF SERVICES

ABERDEEN PROVING GROUND, MARYLAND

PROJECT No: 4270/865

DATE: 19 April 1963 REPORT No: MEO-18-63

MAINTENANCE EVALUATION OF

HOWITZER, LIGHT, SELF-PROPELLED

105-mm XM104

USA REG No. 12T431

DATE OF TEST: 12 Oct 62 to 31 Jan 63

1. INTRODUCTION

The object of this study was to determine the amount and type of maintenance required during a 4000-mile endurance test and to suggest changes to reduce or simplify maintenance.

2. DESCRIPTION OF MATERIEL

The XM104 is being developed to provide a close-support, 105-mm howitzer of minimum size and weight. This 8600-lb track vehicle has a ground pressure of only 3.14 psi, and will swim inland waters. A 105-mm howitzer is mounted at the rear of the hull and can be traversed 22-1/2° to the left or right. The XM104 uses a modified M151 1/4-ton truck engine and the same steer-brake unit used in the M114 and M116 vehicles. The synchro-mesh transmission is the only major power train component not used in other military vehicles.

Six development vehicles are to be built in two groups. The second group of two vehicles will incorporate changes recommended by tests of the first group of four. This report concerns a vehicle in the first group.

3. DETAILS OF TEST

3.1 PROCEDURE

Records were kept of the maintenance required as a result of 4037 miles of endurance test. Only maintenance pertinent to field operations was considered, and time expended in engineering inspections, modifications, awaiting parts, or by other administrative delays is not included. Replacing a serviceable unit with another of different design is considered modification.

3.2 RESULTS

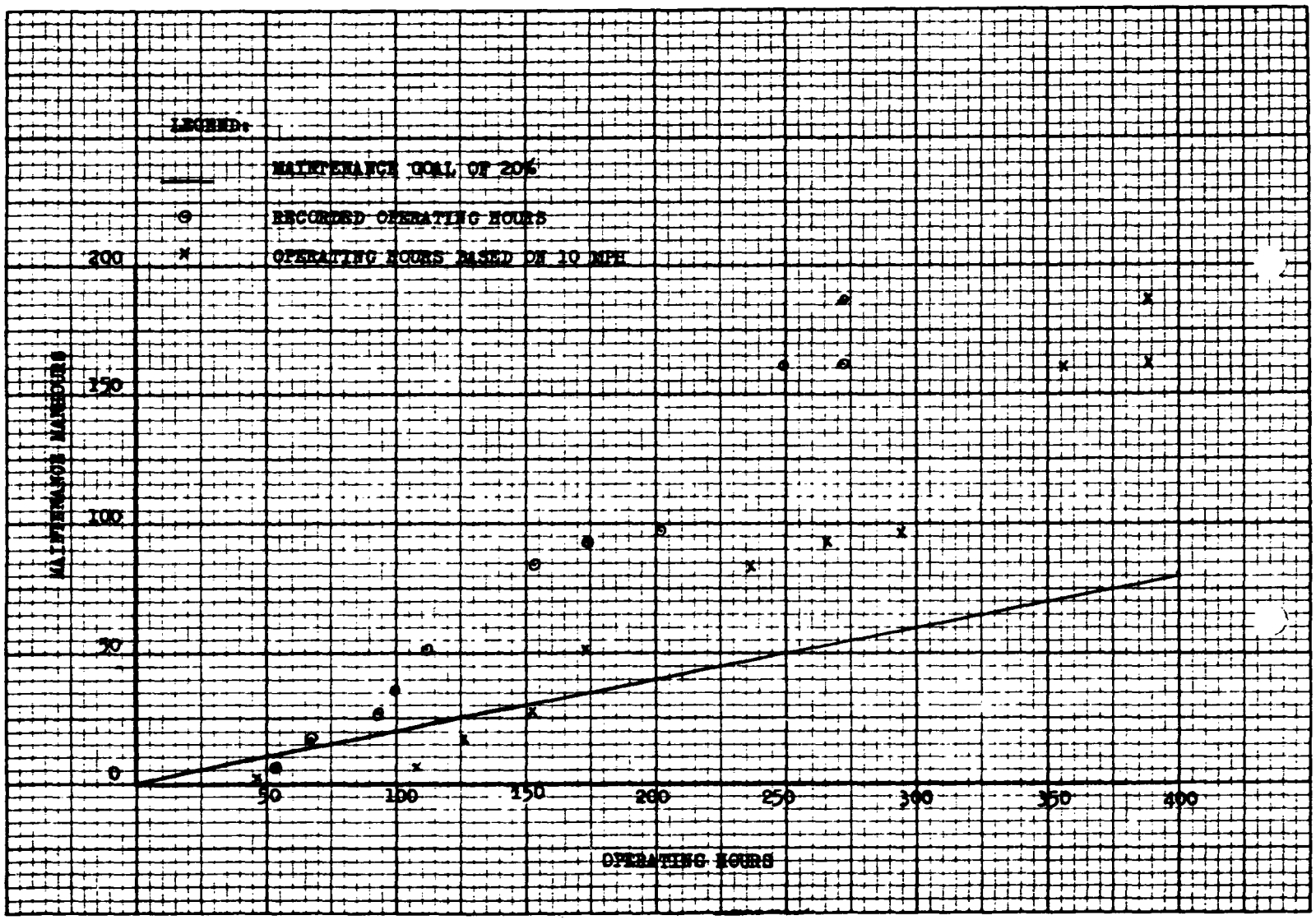
3.2.1 GENERAL

The maintenance criteria for track vehicles, as given in MIL-STD-1228 27 September 1962, requires that vehicles meet the following standards:

(a) 5000 miles without field or depot maintenance.

(b) Total scheduled and non-scheduled maintenance manhours shall not exceed 20% of the operating hours. The criteria considers track vehicles to travel at 10 mph.

A record was kept of the maintenance required for 4037 miles. The 10 mph track vehicle speed assumed by MIL-STD-1228 would have resulted in 403.7 operating hours. An allowance of 20% of this time for both scheduled and non-scheduled maintenance would permit 80.7 hours of maintenance. The average actual speed during the test was 14.3 mph, resulting in 272.5 operating hours and permitting 54.5 maintenance manhours. The total maintenance required at all echelons was 186.2 manhours, or more than twice that permitted by either interpretation of the Military Standard.


LEGEND:
MAINTENANCE GOAL OF 20%
RECORDED OPERATING HOURS
OPERATING HOURS BASED ON 10 MPH
MAINTENANCE MAN-HOURS
200
150
100
50
0
50
100
150
200
250
300
350
400
OPERATING HOURS

The XM104 tested required field or depot maintenance twice for radiator repair, and once each for repair to the clutch release lever support trunnion, the transmission shift lever, and the engine manifold. Of the 156.3 manhours of non-scheduled maintenance, 95 were expended on the power pack, 58 on the tracks and suspension, and the remaining 3 manhours on the remainder of the vehicle.

Table I. MAINTENANCE DATA SUMMARY
(Times are listed in hours)

1. Velocity: the average speed on all courses throughout the test. This speed does not include time when the vehicle was stopped or idling.	14.8 mph
2. Reliability	
a. Total time (100%): operating time plus maintenance time (except depot). The vehicle is considered to be either operating or being maintained. Administrative delays, or those caused by modifications, engineering inspections, or instrumentation are not included.	381.5
b. Time in use	272.5
c. % of time in use: the percentage of total time that the vehicle could operate	71%
d. Time in use and scheduled maintenance	301.7
e. % of time in use and scheduled maintenance: the % of total time the commander could have used the vehicle	79%
f. Non-scheduled maintenance	79.8
g. % of time in non-scheduled maintenance	21%
h. Average operating hours between necessary jobs: the average time the vehicle (or component) could operate between malfunctions that prevented usage. This does not include stops for driver servicing or scheduled maintenance	
(1) Organizational	13.6
(2) Field	90.8
(3) Depot	136.3
3. Amount of Maintenance	
a. Maintenance manhours necessary within each echelon per operating hour	
(1) Driver	.07
(2) Organizational scheduled	.04
(3) Organizational non-scheduled	.50
(4) Field	.05
(5) Depot	.02
b. Maintenance manhours in all echelons per 100 miles	4.6
c. Average operating hours between sched maint:	
(1) Driver servicing: the average time between stops by the driver to inspect, or replenish.	

Table I. (CONTINUED)

3. Amount of Maintenance - Continued

c. (1) Continued:
The necessity to stop was based upon the driver's observation and experience. 3.7

(2) Organizational: time spent in cleaning the vehicle is not included. 21.0

4. Ease of Maintenance

a. Average length of each stoppage: the average duration of stoppage in various echelons of maintenance, that is, the speed with which the job was done and the vehicle returned to use. The amount of maintenance (in 3 above) is given in manhours, whereas ease of maintenance is expressed in downtime.

(1)	Driver servicing	.3
(2)	Organizational sched maint	.7
(3)	Organizational non-scheduled	3.6
(4)	Field	2.3
(5)	Depot	2.0

b. The total time the vehicle, or its components, were removed from use by maintenance at all echelons per 100 miles 2.8

5. Test Course Mileage

Maintenance records were kept during 4037 miles of endurance testing. The mileage was as follows:

(1)	Level cross-country	1008
(2)	Gravel road	1000
(3)	Hilly cross-country	1000
(4)	Paved	978
(5)	Indicated amphibious	51

3.2.2 SPECIFIC

3.2.2.1 ENGINE

a. Power pack replacement requires 2 men 2-1/2 hours. This is twice as long as the time required to replace the power pack of an M60 Tank.

b. A driver dropped the engine oil dipstick into the engine compartment and it could not be recovered until the power pack was removed.

c. The M151 1/4-ton truck dipstick will not give a correct reading for the M151 engine used in the XM104, and a special dipstick is required. The maintenance manuals should warn drivers and mechanics that a lost or broken dipstick cannot be replaced with a 1/4-ton truck dipstick.

d. The driver has difficulty in seeing the engine dipstick tube to insert the dipstick. The driver must replace the dipstick either by removing the engine compartment top cover, or by reaching down through a 3-3/4 x 5-inch opening in the cover and guiding the dipstick into a 1/2-inch diameter hole 11 inches below the cover. The only light by which the driver can see must come through the small opening through which he is reaching.

e. It is difficult to add oil to the engine with the gun tube in the travel lock. The gun tube is 3-3/4 inches above the access door in the engine compartment cover, and this clearance between the gun and cover does not permit the driver to open the access door and place an oil can spout into the engine fill hole. Either the door must be held open with one hand while oil is added with the other, or the gun must be unlocked and elevated. Access openings in the engine compartment top cover could be eliminated, and the cover modified to permit quick removal. This would allow the XM104 engine to be serviced in the same manner as the engine of a wheel vehicle.

3.2.2.2 SUSPENSION

a. The instructions given in the preliminary organizational maintenance manual for torsion bar removal apply only to unbroken bars. Generally, maintenance personnel have no reason to remove torsion bars unless a bar has broken. Following the procedure given in the manual would result in removing only the outer portion of a broken bar.

b. Roadwheel nuts loosen during operation and require frequent inspection and re-tightening. It should be noted that vehicle vibration is very high. A vibration study of the XM104 might be advantageous.

c. Neither the preliminary manual on crew maintenance nor that on organizational maintenance give information concerning track tension

adjustment. The necessity of proper track adjustment is not mentioned in either manual, nor are directions given for adjusting the track or for measuring the adjustment.

3.2.2.3 HULL

a. The plugs in the hull sides that close the openings into the torsion bar anchors and the lock-out cylinders are difficult to remove and require a special tool. The 1-1/2 inch diameter plugs are screwed into the hull and staked in place. The face of each plug is flat with a screw driver slot and two blind holes 3/16-inch diameter by 5/32-inch deep. One of these plugs must be removed to replace a broken torsion bar. Frozen mud in the small holes must be removed to insert a pin spanner wrench. The hull plugs used on the M60-series tanks can be removed by standard box, open-end, or adjustable wrenches, and are less affected by frozen mud.

b. The power pack must be removed to drain the engine oil, because the hull has no engine oil drain hole. Attention is called to this obvious oversight. Time spent in removing the power pack solely for engine oil draining is not included in the maintenance data.

3.2.2.4 WINTERIZATION KIT

The winterization closure must be taken off to remove the power pack. Two men require 1/2-hour to remove the closure and 3/4-hour to install it. The closure is made of can vas supported by bows, and encloses the entire upper portion of the vehicle. The closure cannot be lifted off as an assembly, but must be disassembled and removed in sections. The winterization closure could be modified so that the entire assemble could be lifted off the vehicle as a single unit. The canvas closure could be lifted easily by the four-man crew.

SUBMITTED BY:

Robert Cassilly

ROBERT CASSILLY
Maintenance
Technician

APPROVED BY:

Donald V. D. Domenico CWO-3
for GERALD J. HARBER
CAPT ORDC
Chief, Maint Eng
Office, D&PS, APG
Maryland

OCMC Form 1215a-(5)
15 Sep 61

TYPES OF DEFECTS
A - DEFICIENCY D - DESIGN
B - SHORTCOMING M - MANUFACTURING
C - SUGGESTED IMPROVEMENT

SUMMARY OF DEFECTS
(MAINTENANCE)

TEST 105-mm, XM104, Pilot No. 3

PROJECT NO 427C/865

SNL GRP	VEH NO.	APG NO	TYPE	ITEM	PART NO	PART MILEAGE	REMARKS
0106	431	MEO-1	BD	Engine Oil Dipstick			Engine dipstick cannot be retrieved if dropped
0106	431	MEO-2	BD	Engine Oil Dipstick			M151 1/4-ton truck engine dipstick cannot be used on XM104
0106	431	MEO-3	BD	Engine Oil Dipstick			Engine dipstick replacement difficult
0106	431	MEO-4	BD	Engine Oil Fill			Gun interference with engine dipstick and oil fill
1301	431	MEO-5	BD	Torsion Bars			Inadequate torsion bar removal instructions
1301	431	MEO-6	BD	Roadwheel Nuts			Roadwheel nuts loosen frequently
1303	431	MEO-7	BD	Track Adjustment			No procedure given for track adjustment
1805	431	MEO-8	BD	Hull Access Plugs			Hull plugs difficult to remove
1805	431	MEO-9	BD	Hull Drain			No engine oil drain hole in hull
5049	431	MEO-10	BD	Winterization Closure			Winterization closure must be disassembled for power pack removal

Inclosure #1

MAINTENANCE

DEFECT RECORD

DATE 19 April 63

DEFECT NO.: MEO-APG-XM104-1 ENGINEER: P. Gerard

ITEM UNDER TEST:

VEHICLE TYPE: Howitzer, Self-Propelled, XM104 REG. NO.: 12T431

DATE OF INCIDENT: ODOMETER: PART MILEAGE:

DEFICIENCY [ ] SHORTCOMING [x] SUGGESTED IMPROVEMENTS [ ] DESIGN [x] MANUFACTURING [ ]

SNL GROUP	NOMENCLATURE	PART NO.
0106	Engine Oil Dipstick	

PROBLEM: Engine dipstick cannot be retrieved if dropped into the engine compartment.

SYNOPSIS: A driver dropped the engine oil dipstick into the engine compartment and it could not be recovered until the power pack was removed.

SUGGESTED CORRECTIVE ACTION: Use a light chain to attach the dipstick to the engine.

SUBMITTED BY:

Robert Cassilly

ROBERT CASSILLY
Maintenance
Technician

APPROVED BY:

Donald V. LaDomenico CWO-3
for GERALD J. HARBER
CAPT ORDC
Chief, Maint Eng
Office, D&PS, APG
Maryland

MAINTENANCE

DEFECT RECORD

DATE 19 April 63

DEFECT NO. MEO-APG-XM104-2 ENGINEER P. Gerard

ITEM UNDER TEST

VEHICLE TYPE Howitzer, Self-Propelled, XM104 REG. NO. 12T431

DATE OF INCIDENT ODOMETER: PART MILEAGE

DEFICIENCY [ ] SHORTCOMING [X] SUGGESTED IMPROVEMENTS [ ] DESIGN [X] MANUFACTURING [ ]

SNL GROUP	NOMENCLATURE	PART NO.
0106	Engine Oil Dipstick	

PROBLEM: M151, 1/4-ton truck engine dipstick cannot be used on XM104.

SYNOPSIS: The M151, 1/4-ton truck engine oil dipstick will not give a correct reading for the M151 engine used in the XM104, a special dipstick is required.

SUGGESTED CORRECTIVE ACTION: The maintenance manuals should warn drivers and mechanics that modification of the M151 engine requires the use of a different dipstick in the XM104.

SUBMITTED BY:

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APPROVED BY:

Donald V. LaDomenico Chief-3

for GERALD J. HARBER
CAPT ORDC
Chief, Maint Eng
Office, DAPS, APG
Maryland

MAINTENANCE

DEFECT RECORD

DATE 19 April 63

DEFECT NO. MEO-APG-XM104-3 ENGINEER P. Gerard

ITEM UNDER TEST

VEHICLE TYPE Howitzer, Self-Propelled, XM104 REG. NO. 12T431

TIME OF INCIDENT ODOMETER PART MILEAGE

DEFICIENCY ☐ SHORTCOMING ☒ SUGGESTED IMPROVEMENTS ☐ DESIGN ☒ MANUFACTURING ☐

GROUP	NOMENCLATURE	PART NO.
0106	Engine Oil Dipstick	

PROBLEM: Engine dipstick replacement difficult.

SYNOPSIS: The driver has difficulty in replacing the engine oil dipstick in the dipstick tube. To replace the dipstick, the driver must either remove the engine compartment top cover, or reach down through a 3-3/4 x 5-inch opening in the cover and guide the dipstick into a 1/2-inch diameter hole 11 inches below the cover. The only light by which the driver can see the hole must come through the small opening in the cover.

SUGGESTED CORRECTIVE ACTION: Eliminate all access openings in the engine compartment top cover and modify the cover to permit it to be removed as quickly as the hood of a wheel vehicle.

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MAINTENANCE

DEFECT RECORD

DATE 19 April 63

DEFECT NO. MEO-APG-XM104-4 ENGINEER P. Gerard

ITEM UNDER TEST

VEHICLE TYPE Howitzer, Self-Propelled, XM104 REG. NO 12T431

DATE OF INCIDENT ODOMETER PART MILEAGE

DEFICIENCY ☐ SHORTCOMING ☒ SUGGESTED IMPROVEMENTS ☐ DESIGN ☒ MANUFACTURING ☐

SNL GROUP	NOMENCLATURE	PART NO.
0106	Engine Oil Fill	

PROBLEM: Gun interference with engine dipstick and oil fill

SYNOPSIS: It is difficult to add oil to the engine with the gun tube in the travel look. The gun tube is only 3-3/4 inches above the engine oil access door in the engine compartment cover, and there is sufficient clearance between the gun and the cover to open the access door and place an oil can spout into the engine fill hole. Either the door must be held open with one hand while oil is added with the other, or the gun must be unlocked and elevated.

SUGGESTED CORRECTIVE ACTION: Modify the engine compartment cover to permit easy removal of the cover to service the engine, rather than by reaching through access holes in the cover.

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MAINTENANCE

DEFECT RECORD

DATE 19 April 63

DEFECT NO. MEO-APG-XM104-5 ENGINEER P. Gerard

ITEM UNDER TEST

VEHICLE TYPE Howitzer, Self-Propelled, XM104 REG. NO 12T431

DATE OF INCIDENT ODOMETER PART MILEAGE

DEFICIENCY ☐ SHORTCOMING ☒ SUGGESTED IMPROVEMENTS ☐ DESIGN ☐ MANUFACTURING ☒

SNL GROUP	NOMENCLATURE	PART NO.
1301	Torsion Bars	

PROBLEM: Inadequate torsion bar removal instructions.

SYNOPSIS: The instructions given in the preliminary organizational maintenance manual for torsion bar removal apply only to unbroken bars. Generally, maintenance personnel have no reason to remove torsion bars unless a bar has broken. Following the procedure given in the manual would result in removing only the outer portion of a broken bar.

SUGGESTED CORRECTIVE ACTION: Provide instructions in both the crew and organizational maintenance manuals for the removal of broken torsion bars.

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MAINTENANCE

DEFECT RECORD

DATE 19 April 63

DEFECT NO MEO-APG-XM104-6 ENGINEER P. Gerard

ITEM UNDER TEST

ITEM TYPE Howitzer, Self-Propelled, XM104 REG. NO 12T431

INCIDENT ODOMETER PART MILEAGE

EFFICIENCY ☐ SHORTCOMING ☒ SUGGESTED IMPROVEMENTS ☐ DESIGN ☒ MANUFACTURING ☐

GI GROUP	NOMENCLATURE	PART NO
1301	Roadwheel Nuts	

PROBLEM: Roadwheel nuts loosen frequently.

SYNOPSIS: The roadwheel nuts loosen during operation and require frequent inspection and re-tightening. The roadwheel nuts are of the conventional design used on all track and wheel vehicles. The vibration of this vehicle is excessive.

SUGGESTED CORRECTIVE ACTION: Redesign the drive sprocket to reduce vehicle vibration and provide roadwheel nuts that will remain tight.

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MAINTENANCE

DEFECT RECORD

DATE 19 April 63

DEFECT NO. MEC-APG-XM104-7 ENGINEER P. Gerard

ITEM UNDER TEST

VEHICLE TYPE Howitzer, Self-Propelled, XM104 REG. NO. 12T431

DATE OF INCIDENT ODOMETER PART MILLAGE

DEFICIENCY ☐ SHORTCOMING ☒ SUGGESTED IMPROVEMENTS ☐ DESIGN ☐ MANUFACTURING ☒

ENG. GROUP	NOMENCLATURE	PART NO.
1303	Track Adjustment	

PROBLEM: No procedure given for track adjustment.

SYNOPSIS: Neither the preliminary manual on crew maintenance, nor the preliminary manual on organizational maintenance give information concerning track tension adjustment. The necessity of proper track adjustment is not mentioned in either manual, nor are directions given for adjusting the track or for measuring the adjustment.

SUGGESTED CORRECTIVE ACTION: Provide track adjustment instructions in the crew and organizational maintenance manuals.

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DEFECT RECORD

DATE 19 April 63

DEFECT NO MEO-APG-XM104-8 ENGINEER P. Gerard

ITEM UNDER TEST

VEHICLE TYPE Howitzer, Self-Propelled, XM104 REG NO 12T431

DEFECT INCIDENT ODOMETER PART MILEAGE

DEFICIENCY [ ] SHORTCOMING [X] SUGGESTED IMPROVEMENTS [ ] DESIGN [X] MANUFACTURING [ ]

GROUP	NOMENCLATURE	PART NO
1805	Hull Access Plugs	

PROBLEM: Hull plugs are difficult to remove.

SYNOPSIS: The plugs used in the hull sides to close the openings into the anchor ends of the torsion bars and into the look-out cylinders are difficult to remove and require a special tool. The 1-1/2 inch diameter plugs are screwed into the hull and staked in place. The face of each plug is flat with a screw-driver slot and two blind holes 3/16-inch diameter by 5/32-inch deep for removal. One of these plugs must be removed to replace a broken torsion bar. Frozen mud in the small holes and slot will have to be removed to turn a plug.

SUGGESTED CORRECTIVE ACTION: Provide hull plugs of the same size and type used on the M60-series tanks. The M60 tank plugs have hexagon male drives and are not affected by frozen mud or water and can be removed by standard box, open-end, or adjustable wrenches.

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DEFECT RECORD

DATE 19 April 63

DEFECT NO. MEC-APG-XM104-9 ENGINEER P. Gerard

ITEM UNDER TEST

VEHICLE TYPE Howitzer, Self-Propelled, XM104 REG. NO. 12T431

DATE OF INCIDENT ODOMETER PART MILEAGE

DEFICIENCY [ ] SHORTCOMING [X] SUGGESTED IMPROVEMENTS [ ] DESIGN [X] MANUFACTURING [ ]

SNL GROUP	NOMENCLATURE	PART NO.
1805	Hull Drain	

PROBLEM: No engine drain hole in hull.

SYNOPSIS: The power pack must be removed to drain the engine oil because the hull has no access hole.

SUGGESTED CORRECTIVE ACTION: Provide access holes in the hull floor to allow oil to be drained from the engine, transmission, and the steer-brake unit without removing these components.

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Maryland

MAINTENANCE

DEFECT RECORD

DATE 19 April 63

DEFECT NO MEO-APG-XM104-10 ENGINEER P. Gerard

ITEM UNDER TEST

VEHICLE TYPE Howitzer, Self-Propelled, XM104 REG. NO 12T431

DATE OF INCIDENT ODOMETER PART MILEAGE

EMERGENCY ☐ SHORTCOMING ☒ SUGGESTED IMPROVEMENTS ☐ DESIGN ☐ MANUFACTURING ☒

SYS. GROUP	NOMENCLATURE	PART NO
5049	Winterization Closure	

PROBLEM: Winterization closure must be disassembled for power pack removal

SYNOPSIS: The winterization closure must be taken off to remove the power pack. Two men require 1/2-hour to remove the closure and 3/4-hour to install it. The closure is made of canvas supported by bows, and encloses the entire upper portion of the vehicle. The closure cannot be lifted off as an assembly, but must be disassembled and removed in sections.

SUGGESTED CORRECTIVE ACTION: Modify the winterization closure so that the entire closure can be lifted off the vehicle as a single unit. The canvas closure could be lifted easily by the four-man crew.

SUBMITTED BY:

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APPENDIX F

Radio Suppression Report

U. S. ARMY ELECTRONICS RESEARCH AND DEVELOPMENT LABORATORY
FIELD STATION NR. 1
P. O. Box 6262
Milwaukee 9, Wisconsin

RADIO INTERFERENCE REDUCTION EVALUATION REPORT

SELRA/FS

FS1-17-63
4 Mar 63

SUBJECT: Howitzer, Light, SP, 105MM, XM 104, Manufactured by Detroit Arsenal, Center Line, Michigan

1. SUMMARY:

Interference tests on the subject vehicle revealed that the interference reduction system applied by the Detroit Arsenal conformed to the tactical vehicle requirements of MIL-S-10379A.

2. PROJECT DATA:

a. Suppression Specification: MIL-S-10379A

b. Authorization: Letter STEAP-DS-TU, Development and Proof Services, Aberdeen Proving Ground, 11 Jan 63, subject: "Radio Suppression Tests of Test Vehicles at APG."

c. Contract: None (Experimental Vehicle)

d. Date & Location of Tests: 14-18 January 1963 at Aberdeen Proving Ground, Maryland.

e. Participating Personnel:

(1) Development & Proof Services, APG:
Mr. E. C. Kotras, Tracked Vehicle Branch
Captain D. E. Heidecker

(2) USAELRDL Field Station Nr. 1, East Coast Detachment:
Mr. Fred B. Alvarez, Project Engineer

3. EQUIPMENT:

a. Description: The XM104, howitzer, light, SP, 105MM, is an experimental vehicle utilizing a Ford Model 151 (Ordnance #8754411) four-cylinder, liquid-cooled, gasoline engine rated 70 HP at 4000 RPM. The engine utilizes a 24-volt battery starting and charging system and an ignitor (Combination coil-distributor) ignition system. Electrical accessories include an Ordnance #8763300 bilge pump and MS-51321-1 fuel pump.

b. Radio Interference Producing Devices:

(1) Engine - Ford Model M151

(a) Four (4) Spark Plugs - Auto-Lite AR5S

(b) Ignition Unit - Auto-Lite (Ordnance #7044048)

(c) Alternator - Curtiss-Wright 14R05S24 (DTA #95156)

(d) Regulator - Curtiss-Wright (DTA #95056)

(2) Bilge Pump - Piqua Model 32-17-19 (Ordnance #8763300)

(3) Fuel Pump - Bendix (MS-51321-1)

4. PROCEDURE.

a. Preliminary Examination: A visual examination of the vehicle revealed no discrepancies in the radio interference reduction system applied by the Detroit Arsenal.

b. Test Procedure: Tests for radiated interference were conducted over the frequency range of 0.15 thru 1000.0 megacycles with the antenna of the test equipment located and oriented as prescribed in the applicable sub-paragraphs under paragraph 4.3 of the governing specification. Tests for conducted interference were performed at the slave receptacles of the vehicle over the frequency range of 1.5 thru 40.0 megacycles.

c. Permissible Limits: The following permissible limits of interference prescribed by Military Specification MIL-S-10379A were utilized throughout the investigation:

Test Equipment	Frequency Range (Megacycles)	Permissible Limits (Microvolts per Kilocycle)
Radiated Interference		
Test Set AN/URM-3	0.15 to 40.0	0.75
Test Set AN/URM-7	40. to 95.0	0.1
	95.0 to 1000.0	0.2
Conducted Interference		
Test Set AN/URM-3	1.5 to 10.0	10.0
	10.0 to 40.0	5.0

d. Test Results: Tests performed on the subject unit as submitted by the manufacturer revealed no radiated or conducted interference in excess of the permissible limits cited above.

5. RADIO INTERFERENCE REDUCTION SYSTEM:

a. Details of the interference reduction system applied to the vehicle sub-assemblies and accessories could not be verified at the time of the investigation because the items were inaccessible and manufacturer's drawings were not available at Aberdeen Proving Ground.

b. Review of data obtained in previous investigations of similar equipment indicates that:

(1) The Ford Model M151 (Ordnance #8754411) engine ignition system is suppressed as described in Annex 214I-4G-24-I.

(2) The Piqua Model 32-17-19 (Ordnance #8763300) bilge pump is suppressed in the manner described in Annex 308-3-3.

(3) The MS-51321-1 fuel pump is suppressed as described in Annex 303-1-1.

Details of bonding to the unit frame are not included but in order to assure interference-operation throughout the life of the unit, the sub-assemblies should be bonded with tinned copper braid bond straps and/or plated tooth-type lockwashers.

c. This Station has no previous data regarding the interference reduction system utilized for the Curtiss-Wright Model 14R05S24 charging alternator and associated regulator.

d. Supplementary Comments:

(1) All tooth-type lockwashers and other hardware utilized as components of the radio interference reduction system shall be plated as required by paragraph 3.11.4 of Military Specification MIL-S-10379A.

(2) Whenever in this report purveyors of any products are mentioned by name, it is understood and agreed that similar and equal products of other purveyors will be acceptable. The final decision of what is to be considered "similar and equal" shall rest with the contracting officer or his duly authorized representative. The contracting officer will supply, upon request, a list of approved components and their sources.

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SELRA/FS

FSl-17-63
4 Mar 63

6. CONCLUSIONS:

It is concluded that the radio interference reduction system applied to the XM104 Howitzer, Light, SP, as described herein conforms to the requirements of Military Specification MIL-S-10379A.

7. INCLOSURES:

a. Annex 214-4G-I, Radio Interference Reduction System for Ford M151 (Ordnance #8754411) Engine - Ignition System.

b. Annex 303-1-1, Radio Interference Reduction System for Bendix Fuel Pump.

c. Annex 308-3-3, Radio Interference Reduction System for Piqua Machine & Mfg. Co. DC Motors.

3 Incls
as

/s/ [illegible]
for/t/ F. B. ALVAREZ
Project Engineer

APPROVED:

/s/John S. Kasprowski
/t/JOHN S. KASPROWSKI
Chief Engineer
USAELRDL Field Station Nr. 1

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RADIO INTERFERENCE REDUCTION SYSTEM

SELRA/FS

Annex 214I-4G-24-I
4 March 1963

1. Item: Ford M151 (Ordnance #875411) Engine - Ignition System

2. Specification: MIL-S-10379A

3. Interference Reduction System (FS1-59-60)

a. Four (4) integrally shielded and suppressed spark plugs, Auto-Lite AR5S.

b. The integrally shielded and suppressed ignition unit (Ordnance #7044048) incorporates a feed-thru capacitor.

c. Each of four (4) high tension leads enclosed in rubber covered metallic hose terminated at each end in appropriate threaded fittings.

Incl 1 to FS1-17-63

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RADIO INTERFERENCE REDUCTION SYSTEM

SELRA/FS
3X 90-90-004-06

Annex 303-1-1
17 December 1962

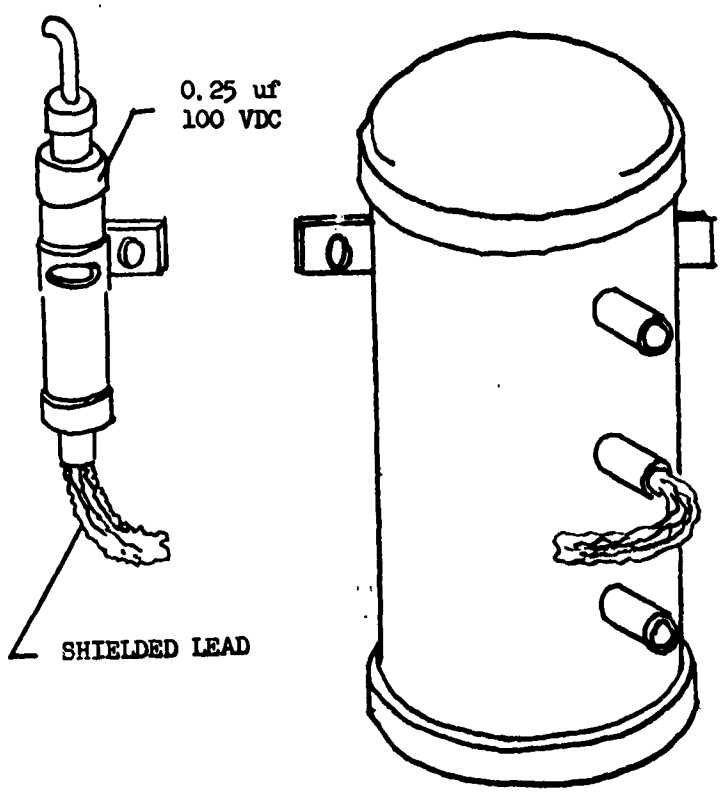
1. Item: Bendix Fuel Pump

2. Specification: MIL-I-11683B, MIL-S-10379A (Tactical)

3. Interference Reduction System:

a. A Cornell-Dubilier NFT-116-3 (or equal), 0.25 uf, 100-volt DC feed-thru capacitor is inserted in the battery lead of the fuel pump.

b. The battery lead from the fuel pump to the feed-thru capacitor enclosed in tinned copper braid shielding terminated at the fuel pump housing and at the feed-thru case with soldered connections.



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RADIO INTERFERENCE REDUCTION SYSTEM

SELRA/FS

Annex 308-3-3
4 March 1963

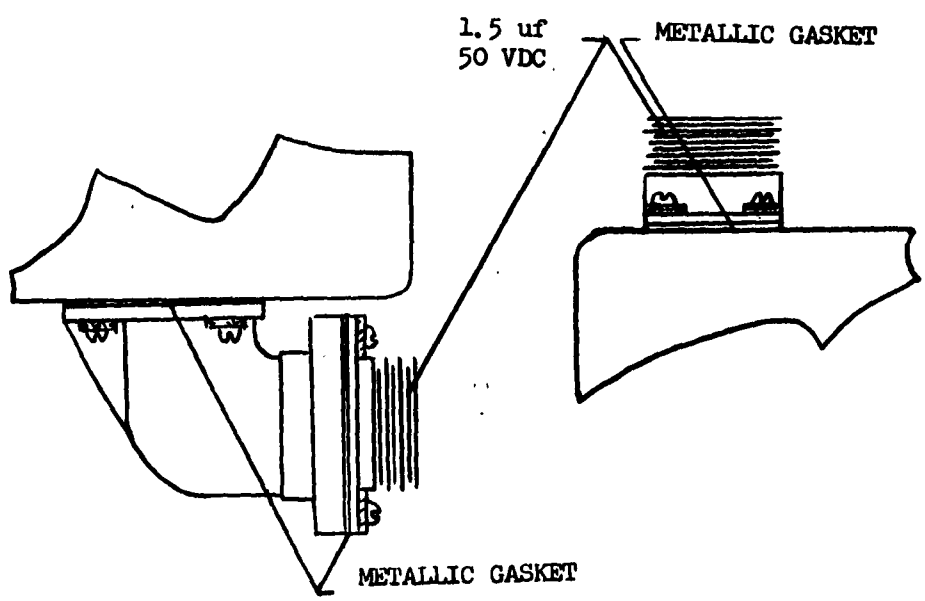
1. Item: Piqua Machine & Mfg. Co. DC Motors

2. Specification: MIL-S-10379A

3. Interference Reduction System: (Letter 3 Nov 53)

a. A Cornell-Dubilier NF1B290, 1.5 uf, 50-volt DC, 60-ampere, feed-thru type capacitor inserted in series with the power input lead.

b. The capacitor is bonded with plated tooth-type lockwashers and metallic gaskets (Detail A or Detail B).



DETAIL A

DETAIL B

Inc. 3 to FS1-17-63

CMMG Form 1415a-(R)
15 Sep 62

SUMMARY OF DEFECTS

TYPES OF DEFECTS

A - DEFICIENCY D - DESIGN

B - SHORTCOMING M - MANUFACTURING

C - SUGGESTED IMPROVEMENT

TEST: Howitzer, Light, SP, 105-mm, XM104

PROJECT NO: OMS 5520.42760.05.01

SNL GRP	VEH NO.	APG NO.	TYPE	ITEM	PART NO.	PART MILEAGE	REMARKS
06		1	A-M	Voltage regulator		115	Failed to regulate, replaced.
06		2	C-D	Eyebolt, battery		N/A	Threads too short.
31		3	C-D	OVE stowage		N/A	Availability of wrench.
18		4	C-D	Covers, engine and transmission		N/A	Accessibility.
31		5	B	OVE items		N/A	Shortage.
17		6	B-D	Cover, air-cleaner, engine		140	Contaminated by mud and small stones.
15		7	B-M	Vehicle vibration cracks		509	Driver's protective panel cracked.
14		8	A-D	Steering-linkage cross shaft		1025	Lack of lubrication.
31		9	B-D	Stowage compartment, spade		1238	Not sealed against water.
18		10	B-D	Engine, transmission oil change		824	Drain plug inaccessible.
13		11	A-M	Arm assembly, road wheel		176	Weld failure, replaced.
04		12	B-D	Exhaust pipe, engine		1664	Rubbing on radiator.
06		13	B-M	Transmitter, engine temperature	6685-506-1039	1568	Defective, replaced.
09		14	A-M	Pump assembly, output oil	8351356	1664	Bracket failure, repaired.
17		15	B-D	Baffle plate		1681	Cracked, repaired.
22		16	B-D	Kit, flotation		1672	Water leaks, repaired.
01		17	A-M	Flywheel housing assembly		1760	Broken clutch trunnion lever, replaced.
07		18	B-M	Shift lever, transmission		2171	Broken, repaired.
01		19	A-M	Oil pickup and screen assembly	10884968	2341	Broken, replaced.
13		20	B-M	Bearing, plain, self-aligning	7748707	2519	Worn, replaced.
04		21	B	Manifold, engine exhaust	8754032	2519	Gases escaping, tightened.
06		22	B-M	Indicator, engine temperature	8380916	2519	Defective, replaced.
20		23	B-M	Spring, spade uplatch assembly	DTA 96248	2683	Broken, replaced.
14		24	B-M	Spring, steering column	DTA 87154	2845	Broken, replaced.
13		25	A-M	Track band	DTA 69409	3098	Broken, replaced.
01		26	B-M	Gasket, engine, head	2805-678-1367	3099	Leaking, replaced.
03		27	B-D	Element, air cleaner	DTA 87162	3099	Deformed, replaced.
01		28	B-M	Tube, engine oil dipstick		85	Loose, tightened.

AMSSC Form 1415a-(R)
18 Sep 61

SUMMARY OF DEFECTS

TYPES OF DEFECTS

A - DEFICIENCY D - DESIGN

B - SHORTCOMING M - MANUFACTURING

C - SUGGESTED IMPROVEMENT

TEST: Howitzer, Light, SP, 105-mm, XM104

PROJECT NO: OMS 5520.42760.05.01

SNL GRP	VEH NO.	APG NO.	TYPE	ITEM	PART NO.	PART MILEAGE	REMARKS
13		29		Track band	DTA 69409	3388	Failed, temporarily replaced.
13		30		Track, left	DTA 69409	3753	Improper adjustment.
06		31		Alternator		4180	Defective, replaced.
14		32		Manual selector level		4187	Broken, repaired.
15		33		Torque arm bracket		4187	Broken, repaired.
18		34		Driver's seat	DTA 96085	4187	Worn.
18		35		Gun travel lock		4187	Worn.
18		36		Ammunition stowage compartments		4177	Cracks.

APPENDIX II

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AD_____ Accession No._____
D&PS, Aberdeen Proving Ground, Maryland
ENGINEER DESIGN TEST OF HOWITZER, LIGHT, SELF-PROPELLED, 105-MM, XM104 P. Gerard

Report No. DPS-955, May 1963
AMCMS Code No. 5564.12.42703.05.1
D. A. Project No. 545-03-030
Unclassified Report

The XM104 self-propelled howitzer, pilot No. 3, was tested to determine the readiness of the weapon system for engineering and user tests. The automotive program consisted of amphibious operations and 4000 miles of endurance testing. From test results, it is recommended that the vehicle undergo engineering and user tests after the appropriate modifications are made in the problem areas revealed.

AD_____ Accession No._____
D&PS, Aberdeen Proving Ground, Maryland
ENGINEER DESIGN TEST OF HOWITZER, LIGHT, SELF-PROPELLED, 105-MM, XM104 P. Gerard

Report No. DPS-955, May 1963
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